SCIENCE & EDUCATION Impact

Benefits From the USDA/Land-Grant Partnership

Plant and Animal Genome Mapping

Crucial roadmaps to better crops and animals.

Imagine how long it took geographers to create detailed maps pinpointing the exact location of towns and cities—a long time, no doubt. Now, agricultural scientists are creating maps for economically important plants and animals that pinpoint where every gene lies on a chromosome. With today's technology and a team approach, scientists predict that most, if not all, of these genes will be located by 2005. After finding genes for beneficial traits such as disease resistance and meat quality, U.S. Department of Agriculture (USDA)/Land-Grant researchers will develop new plant varieties and animal strains to provide consumers with better, more nutritious foods.

Payoff

- **Bran' new wheat and oat resistance.** Scientists at **Cornell** have completed genetic maps for wheat and oats that identify locations of key genes for resistance to insects and to diseases such as leaf rust and powdery mildew. These maps will cut the time and costs associated with breeding, saving U.S. cereal breeders up to $10 million per year. Wheat and oat varieties genetically engineered with these traits are projected to save U.S. producers more than $200 million annually in pesticide costs and crop losses.

- **Fewer bees, more pollination.** Honey bees are the single most important pollinators of flowering plants. However, Africanized honey bees and parasitic mites have greatly reduced the numbers of honeybee colonies. **California** scientists have identified three genes, present in some bees, that increase pollen foraging. Bees selected for this genetic trait pollinate at an 80-percent higher rate and should compensate for the reduced numbers of bees in the state.

- **More piglets.** Pork producers eliminate 30 percent of sows because of small litter sizes. **Iowa State** researchers identified two pig genes that influence litter size and developed methods to identify pigs carrying the genes. Herds improved with these pigs would help producers with 1,000-sow operations see a $20,000 annual increase in profits.

RESEARCH, EDUCATION, AND EXTENSION AT WORK

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- **Beetle-resistant potatoes.** The potato ranks fifth among major food crops and is a food source in almost every country in the world. Each year, potato growers spend $75 million to $100 million to control the Colorado potato beetle, the crop's most destructive pest. Over the years, hundreds of compounds have been used to control the beetle, but the insect consistently develops resistance. **New Mexico State** scientists have addressed the problem by inserting a gene in the potato. The gene acts as a natural beetle repellent and doesn't harm humans or animals. In field trials at **Michigan State**, beetles infested ordinary potatoes but did not eat or even land on the new variety. Working with **Rutgers**, New Mexico scientists are also inserting the gene in the eggplant to make it resistant to the insect.

- **Databases eliminate duplicative efforts.** Researchers from USDA and the Land-Grant universities are working together to collect genetic information that can help create better plants and animals. This information, shared on databases on the World Wide Web, is maintained by scientists from **Colorado State, Cornell, Illinois, Iowa State, Kansas State, Maryland, Missouri, North Dakota, Ohio State, Rutgers, Stanford, Texas A&M,** and **Washington State.** The databases have helped keep costs down by eliminating overlapping efforts.

- **Common plant ancestor, common gene location.** Many genome mapping efforts for various crops are underway—efforts that can be costly and time-consuming. A **Texas A&M** researcher has discovered that grasses and broadleaf plants, which include most major crops, have similar gene orders due to a common ancestor of 130 million to 200 million years ago. Researchers could speed up crop improvements and save millions of dollars by creating a genetic map of *Arabidopsis*, a small flowering plant with the smallest plant genome—25,000 genes. In turn, this map will be used for finding genes in more complex plants such as rice, sorghum, and corn.

- **Hardy tomatoes.** Root-knot nematodes are one of the most serious pests of cultivated crops. Fortunately, some plant species have genes that make them resistant to the nematodes. Researchers in **California** have isolated a gene in tomatoes that imports resistance to the pest when inserted into nonresistant varieties. The next step: incorporating the gene into other crop plants.

- **Tender, less-fat beef.** Researchers at **USDA, Arizona, Colorado State, Georgia, Iowa State,** and **Texas A&M** have identified genes influencing cattle growth and beef yield and quality, including five genes that influence beef tenderness and four genes that control fat marbling. Overall, the number of genetic markers found by this group grew from about 400 in 1994 to an estimated 2,000 in 1997. Mapping the genes will assist the scientists in cloning the genes and in breeding cattle with the desired traits more quickly.

- **Soldiers against soybean pests.** Through genetic engineering, scientists at **Kentucky** have produced soybeans that are naturally resistant to the bean pod mottle virus. The researchers are on the way to breeding new soybean plants that are resistant to the virus and that have seeds with higher levels of oil and protein.

- **Researchers put spider lamb to rest. Utah** and **Illinois** researchers have identified the gene that makes black-faced sheep resistant to spider lamb syndrome, a costly genetic disorder that results in long, fine-boned legs and humped, twisted spines.

- **Dairy do-gooders.** Scientists from **USDA, Arizona, Illinois, Maryland, Virginia Tech,** and **Wisconsin** have joined forces to combat dairy cattle diseases and increase milk quality and yields through genetics. The researchers have located the gene that offers cattle resistance to bovine leukemia and have found genetic markers for resistance to mastitis as well as for improved milk yields and composition.

USDA **United States Department of Agriculture**
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